Critical Environment Technologies

INSTALLATION & INSTRUCTION MANUAL

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AST "X" SERIES
SENSOR - TRANSMITTERS
Explosion-proof

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IMPORTANT NOTICE

READ AND UNDERSTAND THIS OPERATION MANUAL PRIOR TO USING THIS INSTRUMENT.

THIS INSTRUMENT SHOULD BE INSPECTED AND CALIBRATED AT REGULAR INTERVALS BY QUALIFIED AND TRAINED PERSONNEL. FOR MORE INFORMATION REFER TO THE “CALIBRATION” SECTION OF THIS MANUAL.

THIS INSTRUMENT HAS BEEN DESIGNED TO BE INSTALLED IN AREAS CLASSIFIED HAZARDOUS (EXPLOSION RATED). CHECK THE HAZRADOUS AREA RATINGS LISTED FOR THE ENCLOSURE AND SENSOR BEFORE INSTALLING IN A HAZARDOUS AREA.

INSTRUMENT SERIAL NUMBER: ___________________________________

PURCHASE DATE: ____

PURCHASED FROM: ____

WARRANTY

CRITICAL ENVIRONMENT TECHNOLOGIES CANADA INC. WARRANTS THIS INSTRUMENT TO BE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP FOR A PERIOD OF TWO YEARS (ENCLOSURE AND ELECTRONICS), ONE YEAR (CATALYTIC SENSOR HEAD), ONE YEAR (ELECTROCHEMICAL TOXIC OR OXYGEN SENSOR ELEMENTS) FROM THE DATE OF PURCHASE. THE WARRANTY STATUS MAY BE AFFECTED IF THE INSTRUMENT HAS NOT BEEN INSTALLED AND MAINTAINED AS PER THE INSTRUCTIONS INDICATED IN THIS MANUAL OR HAS BEEN ABUSED OR DAMAGED IN ANY WAY. THIS INSTRUMENT IS ONLY TO BE USED FOR PURPOSES STATED HEREIN.

APPLICATION

THE MODEL AST "X" SERIES HAVE BEEN DESIGNED AS REMOTE MOUNT ANALOG SENSOR / TRANSMITTERS FOR THE DETECTION OF COMBUSTIBLE GASES AND VAPOURS, TOXIC GASES OR OXYGEN. THESE INSTRUMENTS ARE DIFFUSION DEVICES. THEY OPERATE ON POWER SUPPLIED BY A REMOTE SOURCE AND PROVIDE A ANALOG SIGNAL REPRESENTING THE QUANTITATIVE CONCENTRATION OF TARGET GAS MEASURED. THEY WILL OPERATE WITH ANY GENERIC CONTROL DEVICE THAT ACCEPTS 4 - 20 MA OR 0-10 VDC ANALOG SIGNAL.

SELECTING AN INSTALLATION LOCATION SHOULD BE IN ACCORDANCE WITH LOCAL REGULATIONS, PROJECT ENGINEERING SPECIFICATIONS AND MANUFACTURERS SPECIFICATIONS.

ENVIRONMENT

THE CAST ALUMINUM, EXPLOSION-PROOF JUNCTION BOX UTILIZED FOR THE AST "X" SERIES OF INSTRUMENTS IS WATER AND DUST TIGHT, WHEN INSTALLED CORRECTLY. ENSURE THAT A LIQUID TIGHT CONDUIT FITTING IS UTILIZED TO MAINTAIN THE SAME LEVEL OF PROTECTION. THE SENSOR HEAD HOUSING THE CATALYTIC COMBUSTIBLE SENSOR IS MADE OF 316 STAINLESS STEEL. THE SENSOR HEAD HOUSING THE TOXIC OR OXYGEN SENSOR IS MADE OF MACHINED ALUMINUM. THIS SERIES OF TRANSMITTERS HAVE BEEN DESIGNED TO BE INSTALLED IN CLASSIFIED HAZRADOUS (EXPLOSION RATED) AREAS. CHECK THE HAZRADOUS AREA RATINGS LISTED FOR THE ENCLOSURE AND SENSOR BEFORE INSTALLING IN A HAZARDOUS AREA.

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1.0 GENERAL DESCRIPTION

The model AST X" series are analog transmitters designed to be remote mounted for the detection of combustible gases and vapours, toxic gases or Oxygen in classified hazardous areas (explosion rated environments). They are housed in a cast aluminum, explosion-proof, water / dust tight junction box with attached sensor housing.

AST X" series transmitters provide continuous monitoring with continuous analog signal output, representing the quantitative measurement of the presence of a "target" gas. The industry standard 4 - 20 mA or 0 - 10 VDC signal is linear and can be "fed" into a building management system, plc or any generic controller that will accept one of these analog signals. The controlling device can then be utilized to provide a measure of control and alarm.

Glossary:

a) LEL: "Lower Explosive Limit" Lowest concentration of a combustible gas in air that will support combustion when exposed to an ignition source.

b) UEL: "Upper Explosive Limit" A point at which the concentration of combustible gas in air exceeds the maximum concentration that will support combustion.

c) Inhibitors: Substances that produce a temporary loss of pellistor sensitivity.

d) Poisons: Substances that produce a permanent reduction in pellistor sensitivity.

e) PPM: "Parts Per Million" The accepted unit of measure for toxic gases

1.1 SENSORS

All AST "X" series transmitters utilize poison-resistant, catalytic pellistor sensor elements to detect combustible gases and vapours. Catalytic pellistor sensors are designed to provide good accuracy and selectivity to "target" combustible gases and vapours. They are very stable over long periods and require minimal maintenance (two to four times per year calibration).The affect of moderate swings in temperature and humidity are only minimal on these sensors. Avoid contact with or installation in areas containing potential inhibitors or poisons as described in the glossary above. For more information, see note-4 and note-5 on page 15.

Electrochemical sensor elements are utilized for the detection of toxic gases or Oxygen and are, for the most part, gas specific. They are quite stable over long periods and require minimal maintenance (two to four times per year calibration). The affect of moderate swings in temperature and humidity are only minimal on these sensors. Avoid contact with high concentrations of solvent vapours.

2.0 TRANSMITTER SPECIFICATIONS

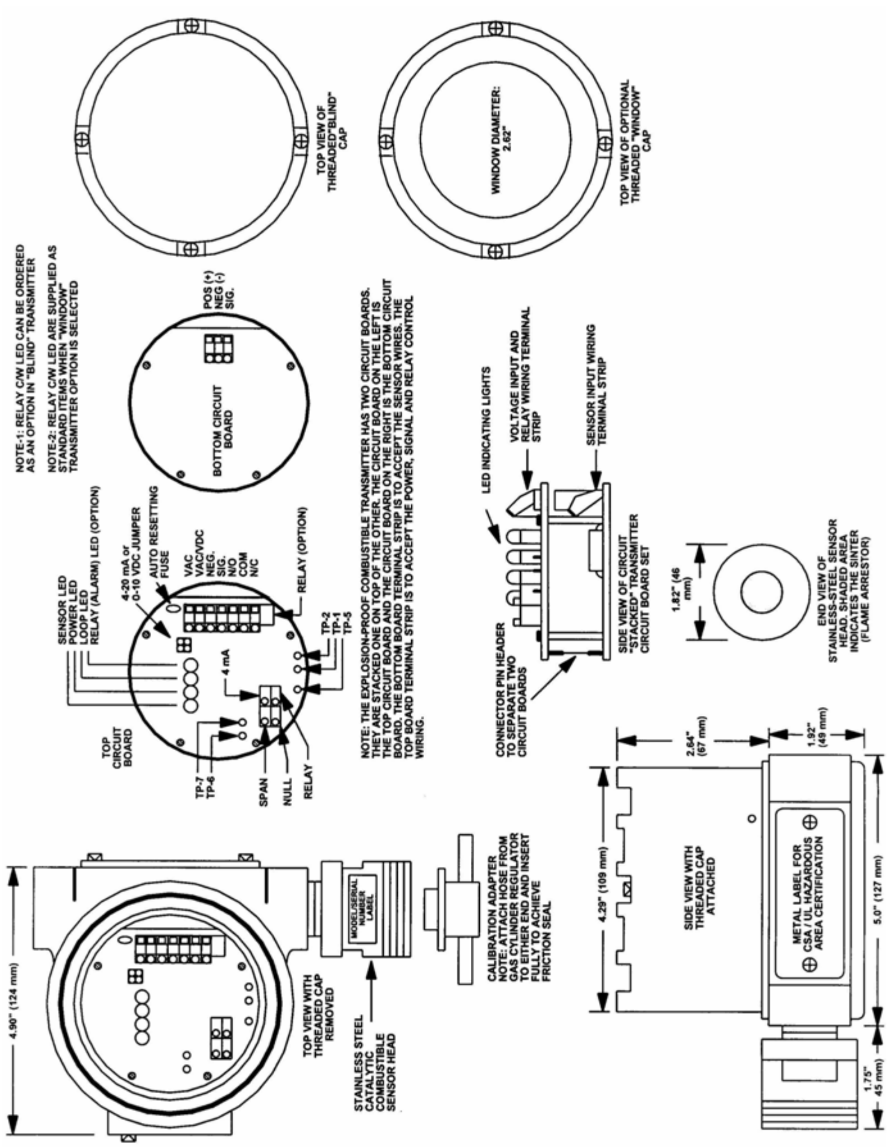
Size:	Combustible version 4.92” X 6.75” X 4.56” (junction box) 125 mm X 171 mm X 116 mm Toxic / Oxygen version 4.92” X 7.85” X 4.56” 125 mm X 199 mm X 116 mm
Weight:	1.72 pounds (780 grams)
Construction:	Junction box: Cast aluminum, explosion-proof Combustible sensor housing: 316 Stainless steel Toxic/Oxygen sensor housing: Machined aluminum or stainless steel
Power:	20 to 30 VDC or 16 to 28 VAC approximate current draw: 250 mA
Output Signal:	Linear, analog 4 - 20 mA or 0 - 10 VDC jumper selectable
Loop Resistance:	Maximum 1000 Ohms
Bridge Voltage:	Standard 2.0 VDC for poison resistant catalytic pellistor sensor (this spec applies only to combustible sensors)
Adjustments:	Combustible sensor Bridge: Setting sensor heater voltage at time of installation of a new sensor Toxic, Oxygen or combustible sensors Null: Setting transmitter “ZERO” point 4 mA: Setting 4 mA output signal Span: Setting transmitter for gas accuracy Option for any of the above transmitters Relay: Setting alarm set point

2.1 SENSOR SPECIFICATIONS

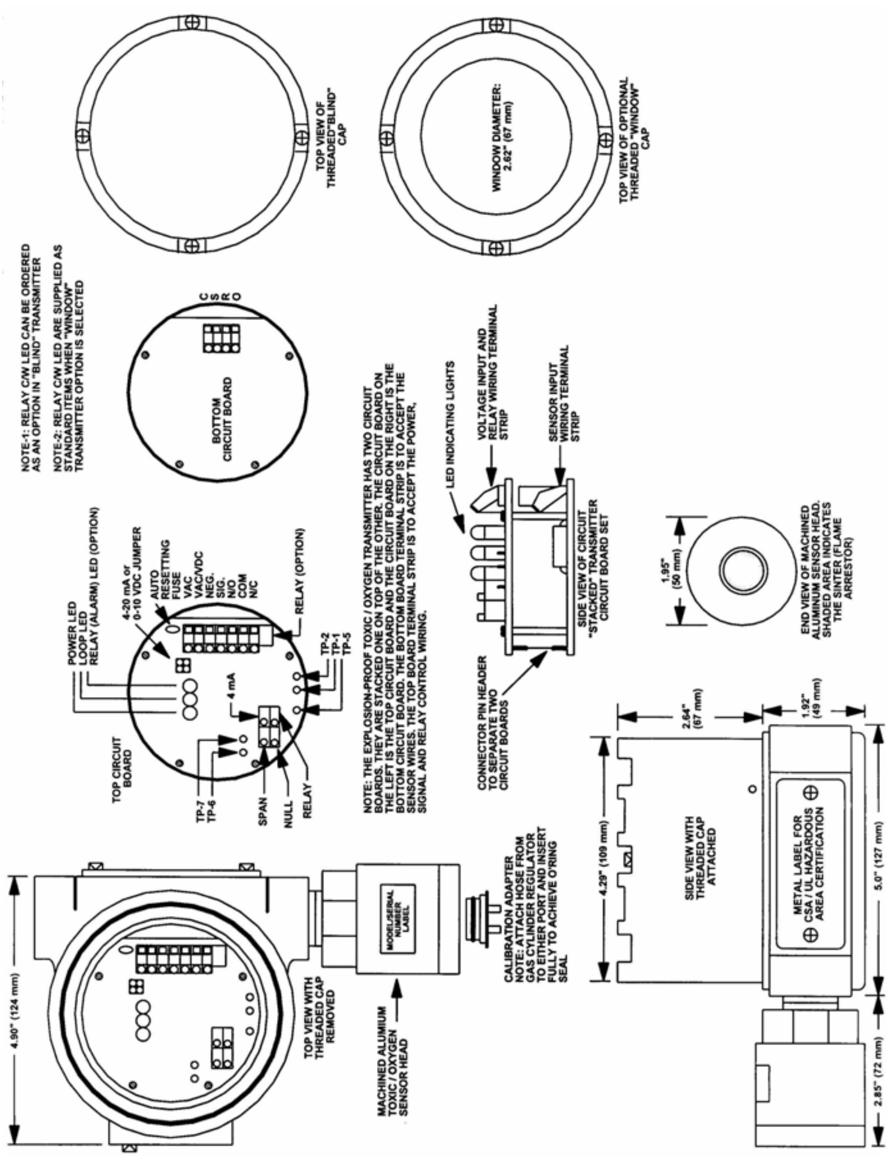
Combustible:	Poison resistant, catalytic pellistor element
Oxygen:	Type: Electrochemical Range: 0 -25.0 % Volume Resolution: +/- 0.25% Volume
Toxic:	Type: Electrochemical

	Range	Resolution	Operating Temp.
Ammonia	0 -200 ppm	1 ppm	-25 C to +30 C
Ammonia	0 -1000 ppm	5 to 8 ppm	-20 C to +40 C
Chlorine	0 -5.0 ppm	0.1 ppm	-20 C to +40 C
Carbon Monoxide	0 -250 ppm	1 ppm	-20 C to +50 C
Ethylene Oxide	0 -20.0 ppm	0.1 ppm	-20 C to +50 C
Hydrogen	0 -2000 ppm	2 ppm	-20 c TO +50 C
Hydrogen Cyanide	0 -20 ppm	1 ppm	-20 C to +50 C
Hydrogen Sulphide	0 -50 ppm	1 ppm	-40 C to +50 C
Nitrogen Dioxide	0 -5.0 ppm	0.5 ppm	-20 C to +50 C
Nitric Oxide	0 -100 ppm	1 ppm	-20 C to +50 C
Ozone	0 -1.00 ppm	0.02 ppm	-10 C to +40 C
Sulphur Dioxide	0 -20 ppm	0.5 ppm	-20 C to +50 C

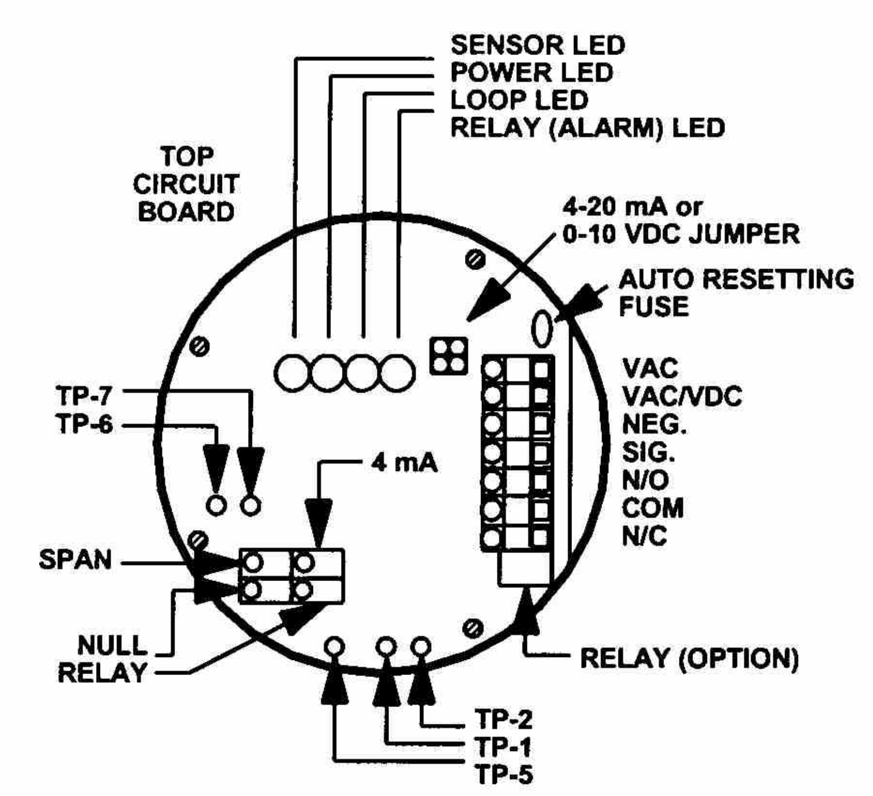
3.0 COMBUSTIBLE TRANSMITTER DRAWING



3.1 TOXIC / OXYGEN TRANSMITTER DRAWING



4.0 UPPER (MAIN) CIRCUIT BOARD KEY COMPONENTS



NOTE-1: The upper (main) circuit board is common to all types of sensors.

NOTE-2: The "sensor LED" indicated in the above drawing pertains only to the catalytic combustible sensor element. The above circuit is unable to detect an expired electrochemical sensor element.

4.1 TRANSMITTER INSTALLATION INSTRUCTIONS

The explosion-proof junction box supplied is a conduit mount style. The transmitter enclosure should be installed with stainless steel sensor diffusion head pointing downward (vertical position). Utilize liquid tight conduit hubs to ensure liquid does not enter the enclosure through the conduit / wiring entrance.

<u>Sensor Mounting Heights and Locations (Examples)</u>

Methane (CH_4) and Hydrogen (H_2) are much lighter than air and so the transmitter should be installed on or near the ceiling.

Propane (C_3H_8) is much heavier than air and so the transmitter should be installed with sensor approximately 6" from the floor.

Carbon Monoxide (CO) is only slightly lighter than air and so the transmitter should be installed with sensor approximately 4' to 6' from the floor (breathing zone)

Hydrogen Sulphide (H_2S) is heavier than air and so the transmitter should be installed with sensor approximately 6" from the floor.

Nitrogen Dioxide (NO_2) is heavier than air but for many applications the transmitter should be installed with sensor approximately 4' to 6' from the floor. Mounting height is application dependent.

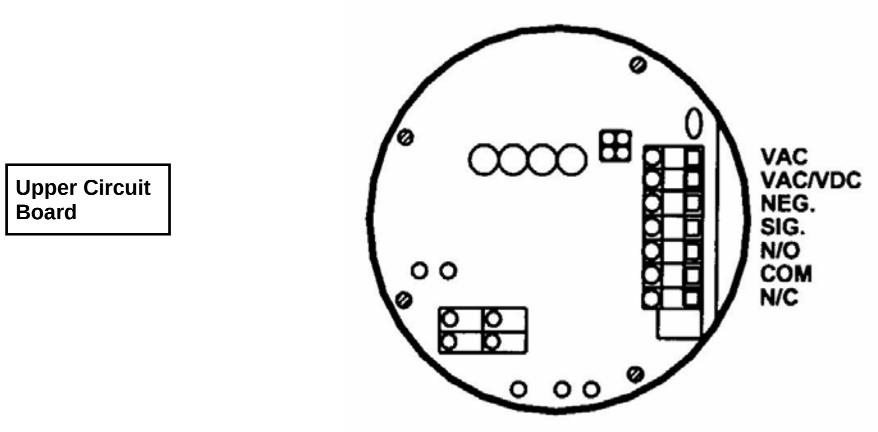
Sulphur Dioxide (SO_2) is heavier than air and so the transmitter should be installed with sensor approximately 6" from the floor.

Ammonia (NH_3) is lighter than air and so the transmitter should be installed on or near the ceiling.

Always ensure that the sensor / transmitter unit is installed at the right mounting height to easily detect the target combustible gas or vapour.

Attach appropriate conduit to transmitter enclosure, utilizing liquid tight fitting to main-

4.2 TRANSMITTER WIRING CONNECTIONS DRAWING



4.3 TRANSMITTER WIRING HOOK-UP INSTRUCTIONS

Utilize 18 - 22 gauge, 3-conductor shielded cable (stranded wire) for VDC connection or 4-conductor for VAC connection. For VDC power, connect positive to terminal “2”, negative to terminal “3” and signal to terminal “4”. For VAC power connect VAC wiring to terminals “1” and “2”, negative to terminal “3” and signal to terminal “4”. ***Double check connections for correct polarity, prior to powering up transmitter.*** Power can be supplied from one of several different control panels manufactured by CETCI, a generic controller manufactured by another company, or a regulated VDC power supply or other such source.

Note-1: The three terminal locations marked (5, 6 & 7) located directly below terminals 1, 2, 3, and 4 are for relay control connections, if this option has been ordered.

Note-2: Observe local regulations with regards to hazardous area installations with regards to conduit type and installation instructions.

5.0 TRANSMITTER OPERATION INSTRUCTIONS

Once power has been connected to the AST-CCB-X (combustible) transmitter, the green “power” LED and the green “sensor” LED will illuminate. The signal output may indicate a fail condition, at the controlling device, for a brief moment while the circuit powers up the catalytic sensor element. The sensor output to the circuit then may rise through the transmitter full measurement range, indicating gas alarm conditions on the controlling device. This condition may last for several minutes or more, depending on how long the transmitter has been without power. Once the sensor has reached peak operating temperature and stabilized, the output signal will automatically settle down to normal operating condition (approximately 4.00 mA or 0.00 VDC signal output in clean air).

Note-1: If the green sensor LED goes out, it means the catalytic pellistor sensor element has burned out.

Note-2: If the red “loop” LED illuminates, it means the signal loop to the controlling device has not been connected properly. Double check the wiring connections. Once the signal has been connected properly, the “loop” LED will go out.

When power has been applied to transmitters with toxic or Oxygen sensor elements, the green “power” LED illuminates and the signal output is usually indicated immediately at the controlling device. These types of sensors should be allowed to stabilize for two to six hours prior to performing a calibration. Transmitters with toxic or Oxygen sensors do not have the green “sensor” LED. These transmitters do have the red “loop” LED.

A powered up sensor / transmitter in normal operating condition will have a linear analog signal output of approximately “4.00 mA” or “0.00 VDC” (depending upon which signal output has been selected by use of the on-board jumpers). Once a combustible gas or vapour has been detected, the signal will rise through the detection range of 4 to 20 mA or 0 –10 VDC. Eg. a concentration of 50% LEL will output 12.0 mA or 5.0 VDC.

Relay option: Both types of transmitters can be ordered with one dry relay contact option. The relay is S.P.D.T. and rated 2 amps @ 28V. When this option has been ordered, the upper circuit board comes with an amber LED which indicates relay coil action and a potentiometer to adjust the set (trip) point for the relay. When the relay coil is energized, the amber LED is illuminated. For more details, see section 6.4 “Adjusting Relay Set Point” further on in the manual.

6.0 TRANSMITTER MAINTENANCE INSTRUCTIONS

All sensor / transmitters should be inspected on site after installation to ensure that they have been installed and connected properly. All sensor / transmitters are factory calibrated, twice, prior to shipping, but an on-site gas test serves to confirm accuracy of zero and span settings, in case they have been tampered with. Regular maintenance is minimal and consists of two to four times per year on-site gas calibration (application dependent).

6.1 CALIBRATION PROCEDURE

IMPORTANT: Ensure sensor / transmitter has been powered up for at least 2 to 6 hours prior to performing any calibration procedure.

Equipment Required:

* Calibration adapter for explosion-proof head
* Precision digital multi-meter with "clip-on" leads
* Small blade screwdriver (to adjust potentiometers)
* Calibration kit with appropriate cylinders of zero emissions air and calibration span gas

Procedure: **4-20 mA current signal**

a) Attach leads from digital multi-meter to test points "TP-6" and "TP-7" (null test points). Set meter to voltage measurement scale of "0.000". Attach calibration adapter and flow zero emissions air (0.2 to 0.7 LPM) over sensor for approximately two minutes. Adjust the "NULL" potentiometer to achieve a reading of "0.000" VDC (or as close as can be achieved).

b) Next, move the meter leads to test points "TP-1" and "TP-2" (signal output test points). With zero emissions air still flowing, adjust the "4 mA" potentiometer to achieve a reading of ".400" VDC.

c) Based on the span calibration gas you are using, calculate the desired signal reading to be expected from the transmitter, using the following formula.

$$\frac{\textbf{Span Gas Concentration}}{\textbf{Sensor Range (100\%)}} \times 16 + 4 = \textbf{Desired mA Signal}$$

Eg. Span calibration gas concentration = 50% LEL CH4
50 / 100 X 16 + 4 = 12.0 mA (1.20 VDC at TP1 and TP2)

Note: *The mA current signal is dropped across a 100 Ohm resistor on the circuit board just before test points TP-1 and TP-2 so the user can measure VDC. The scale is 4-20 mA = 0.400 to 2.00 VDC.*

d) Apply calibration span gas for approximately two to three minutes. Adjust "SPAN" potentiometer to obtain a reading equal to the target voltage as calculated in "c)". Remove span gas and allow sensor to recover for at least ten minutes.

6.1 CALIBRATION PROCEDURE, CONT'D…..

Procedure: **0-10 VDC current signal**

a) Attach leads from digital multi-meter to test points "TP-6" and "TP-7" (null test points). Set meter to voltage measurement scale of "0.000" VDC. Attach calibration adapter and flow zero emissions air (0.2 to 0.7 LPM) over sensor for approximately two minutes. Adjust the "NULL" potentiometer to achieve a reading of "0.000" VDC (or as close as can be achieved). This procedure applies to transmitters with either combustible or electrochemical sensors.

b) Next, move the meter leads to test points "TP-1" and "TP-5" (signal output test points). With zero emissions air still flowing, adjust the "4 mA" potentiometer to achieve a reading of ".000" VDC.

c) Based on the span calibration gas you are using, calculate the desired signal reading to be expected from the transmitter, using the following formula.

$$\frac{\text{Span Gas Concentration}}{\text{Sensor Range (100\%)}} \text{ X 10 = Desired VDC Signal}$$

Eg. Span calibration gas concentration = 50% LEL CH4
50 / 100 X 10 = 5.0 VDC

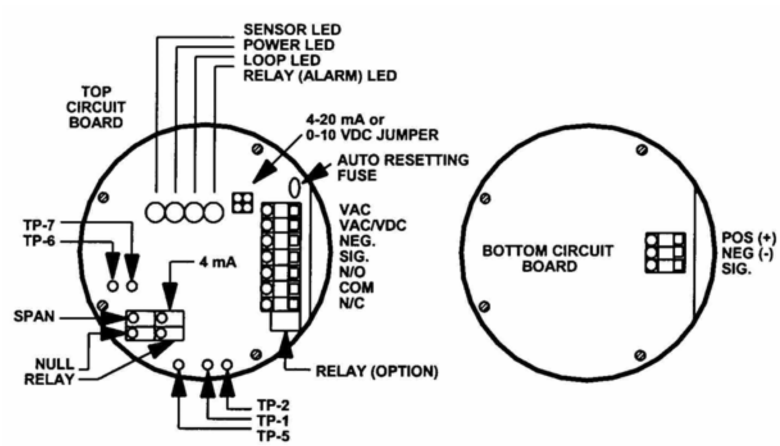
d) Apply calibration span gas for approximately two to three minutes. Adjust "SPAN" potentiometer to obtain a reading equal to the target voltage as calculated in "c)". Remove span gas and allow sensor to recover for at least ten minutes.

e) Circuit design is such that null and span adjustments do not interact. If the sensor does not settle to 0.400 VDC or 0.000 VDC signal output after approximately ten minutes, flow zero emissions air once more and adjust the null potentiometer to obtain a reading of "0.000" VDC. *CAUTION: Do not re-adjust the null potentiometer until sensor has fully recovered.*

f) Calibration procedure is complete. Remove regulator from gas cylinder for storage.

Note: *When a pellistor sensor head has been calibrated with Methane (CH4) and it is being utilized in an area where another combustible gas or vapour is present, a more accurate reading of the new target gas can be obtained by multiplying a theoretical response ratio by the indication obtained from the Methane calibrated head. This derived value should only be utilized as an indication. For more accurate readings of gases other than Methane, calibrate the pellistor sensor with the desired target gas. For more information, contact our sales and marketing department.*

6.2 CALIBRATION ADJUSTMENTS DRAWING



Note-1: The drawing indicated above is for a transmitter with a combustible sensor because the “sensor” LED is shown. The calibration adjustments are exactly the same for the electrochemical sensor version.

Note-2: The drawings in section 3.0 (combustible) and 3.1 (electrochemical) indicate what the calibration adapters for the two basic transmitter types look like and how they attach to the sensor housing. Both adapters are friction fit once inserted and allow hands free operation.

6.3 ADJUSTING RELAY SET POINT

If the relay option has been ordered, the “set” point (trip point) must be adjusted. To achieve this, connect meter leads to “TP1” and “TP2” (if 4-20 mA signal is selected) or “TP1” and “TP5” (if 0-10 VDC signal has been selected).

Next, calculate the set (trip) point using the calibration gas formula from the previous page. To adjust the set point, the circuit must see an elevated signal from a signal generator or other such source. Optionally, adjust the “Null” potentiometer to obtain the desired output signal at “TP1” and “TP2” or “TP1” and “TP5”. Once the desired output signal has been achieved, adjust the relay potentiometer until the amber relay LED illuminates and the relay makes an audible “click”.

Next, reset the null potentiometer to “000 VDC” while measuring at “TP6” and “TP7”. If you are unsure if the measured environment air is clean, flow zero emissions air over the sensor prior to resetting the null again.

Note: If an extremely high set point is desired, the “Null” potentiometer may not provide enough adjustment and a signal generator will be required.

6.4 SENSOR REPLACEMENT INSTRUCTIONS

Combustible sensors:

To replace a sensor head, first disconnect the power to the transmitter. Loosen the three terminal strip screws located on the lower board and remove the existing sensor head wires, carefully noting the colour code sequence (see drawing in section 4.2). Loosen the securing nut and carefully unthread the stainless steel sensor head and remove it.

Install the new sensor head and tighten the securing nut.

Re-attach the three sensor wires, noting the colour code sequence. Power up the transmitter and allow it to stabilize for approximately 2 to 6 hours before attempting to perform a calibration procedure.

NOTE-1: The “Bridge” voltage is factory set and should not have to be adjusted in the field unless someone has tampered with it. If tampering is suspected, do not power up the transmitter until bridge voltage has been checked. *Carefully follow the procedure listed on the next page.*

NOTE-2: All new sensors must be calibrated prior to usage. See section “6.1” of this manual preceding pages, for details.

NOTE-3: ***“IMPORTANT”*** Ensure hands are clean prior to handling sensor head diffusion end to avoid contamination of pellistor sensor elements. Avoid contacting the flame arrestor with any compounds or dirty hands.

6.4 SENSOR REPLACEMENT INSTRUCTIONS, CONT'D…..

Bridge Voltage Adjustment Procedure:

a) Connect only "-" and "sig" wires from the new sensor.

b) Attach meter leads to "TP-1" and "TP-2" on the lower circuit board. Power up the transmitter. The voltage reading should be 2.00 VDC on the meter. If not, adjust the bridge voltage potentiometer "VR1", located just to the left of the test points, to achieve a reading of "2.00" VDC.

Note: The two circuit boards must be connected through the header pins for bridge voltage adjustment to be achieved. To access the potentiometer, the two circuit boards must be separated. An interconnecting cable must be obtained from CETCI to enable the technician to more easily perform this operation.

NOTE-4: Some substances that can cause temporary loss of sensitivity or permanent poisoning to pellistor sensors are: H2S, Silicone compounds, Chlorine, Chlorinated Hydrocarbons, Phosphate esters, Tetra-ethyl lead and most Halogenated compounds.

NOTE-5: Some common sources of contamination include silicone oils and greases on joints and cases, residues of cutting fluids or mould-release compounds on metal or plastic components, furniture polish, degreasing compounds and some paints.

Electrochemical sensors:

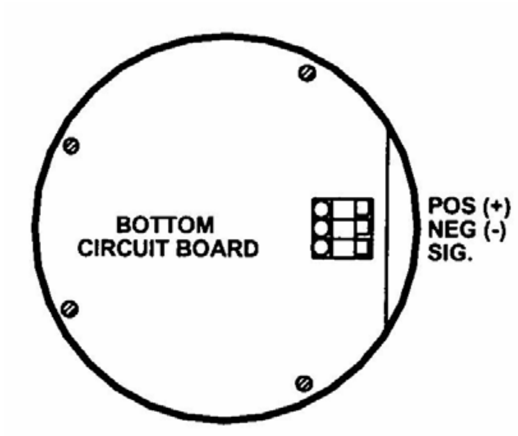
To replace an electrochemical toxic or Oxygen sensor element, first unthread the machined aluminum end cap and remove the existing sensor element. Before inserting a new toxic sensor element, be sure to remove the sensor shorting bar (usually a tiny spring clip). Insert the new sensor element and replace the threaded end cap. In the case of toxic sensors, ensure the new o'ring is still in place before installing the end cap. Carefully thread the end cap down until you encounter resistance, then slowly continue threading it in until it stops.

Note: This procedure can safely be carried out while the transmitter is powered up. However, local regulations or company policies may require that the area be de-classified or the transmitter be powered down before removing the end cap.

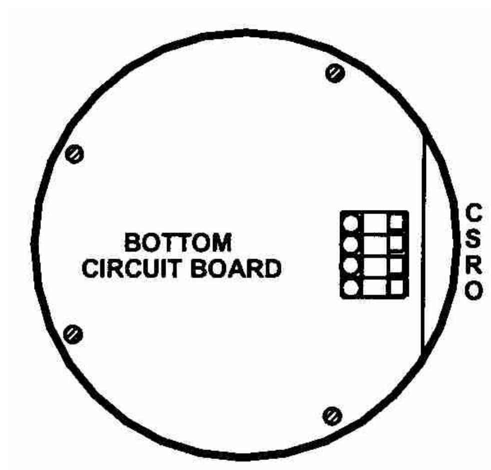
Next, allow the sensor approximately six hours to stabilize then perform a complete calibration procedure (reference procedure in section 6.1).

6.5 SENSOR REPLACEMENT WIRING CONNECTIONS DRAWING

Combustible sensor:



Toxic or Oxygen sensor:



7.0 REPLACEMENT PARTS & ACCESSORIES

DESCRIPTION	PART NUMBER
Calibration adapter (plastic)	FLOWCAPPVC
Transmitter circuit board (upper)	AST-X
Transmitter circuit board (lower)	AST-CX
Replacement stainless sensor head (threaded end)	SEE-1000-SE2
Replacement stainless sensor head (non-threaded end)	SEE-1000-SE1
Splash guard (Delron non-metallic)	SEE-1000-SGP
Splash guard (stainless steel)	SEE-1000-SG
Flow through attachment	FLOW CAP METAL
Gas collector cone	SEE-1000-CC

8.0 ACCESSORIES

Calibration adapter: Plastic, friction fit with molded inlet and outlet fittings to allow attachment of gas flow hose..

Splash guard: Non-metallic, thread-on attachment to help prevent pellistor damage from splashed liquids. Also used in remote sensor calibration applications (has a fitting attached). Specify application at time of ordering.

Splash guard: Stainless steel, thread-on attachment to help prevent pellistor damage from splashed liquids.

Flow through attachment: Stainless steel, thread-on attachment used for directing a sample of air / gas to sensor for sample draw applications.

Gas collector cone: Metal, thread-on attachment for collecting lighter-than-air gases and directing them to the diffusion sensor head for quicker response.

8.0 ACCESSORIES, CONT'D…..

NOTE: All accessories shown on these two pages apply to the combustible sensor version and are shown as being attached to the stainless steel, pellistor sensor head.

CALIBRATION ADAPTER

DELRON NON-METALLIC MACHINED SPLASH GUARD

8.0 ACCESSORIES CONT'D.....

STAINLESS-STEEL SPLASH GUARD

FLOW THROUGH ATTACHMENT

GAS COLLECTOR CONE